Issues for Use of Climate Models to Inform Policymakers, Assess Impacts, and Develop Adaptive Strategies

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Take-Away Messages

- **Impact assessment and scenario development must approach climate model output far more critically, conducting expert and thorough historical record validation of all critical aspects of the problem as a first mandatory step.**
  -- Otherwise the assessments or scenarios may be worthless or, worse, misleading.

- **Model validation needs greater research attention, both to meet user needs above and to sensitize modelers to deficiencies.**
  -- Currently model validation is grossly inadequate.

- **More attention needs to be paid to the development of credible meso-scale (to avoid downscaling compromises) global coupled models that correctly treat the full spectrum of variability.**
  -- Downscaling (whether statistical or with nested models) is inherently flawed.

- **Existing climate models *cannot* credibly produce future weather scenarios of other than the gross geographic and seasonal distribution of mean surface temperature.**

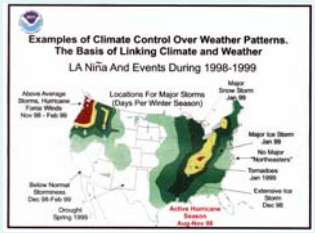
- **This is because they *cannot* adequately reproduce these features over the recent historical record.**

Parameters and/or trend(s)	*Level of practical interest to policy makers, adaptive planners, and resource managers*	*Ability of climate models to reproduce over the last 50 years*
Mean annual global surface temperature	None	Exceptional
Regional and seasonal mean surface temperature and precipitation and their interannual variability	Considerable	Fair to poor for surface temperature and poor for precipitation
Regional and seasonal intraseasonal variability, especially risks of weather extremes and high-impact events	Intense	Poor or unknown

- **To do this models must be able to reproduce the form, seasonality, and variance of the phenomenon that constitute the dominant controls on weather systems and their variability.**

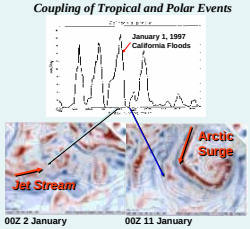
North America Climate/Weather Links

- ***El Nino/La Nina controls:***
  - **Atlantic/Gulf Tropical Storm/Hurricane activity**
  - **Winter storm tracks**
  - **Temperature extremes**
- ***Subseasonal links to tropical variability:***
  - **Most active when El Nino absent or La Nina weak (for example Winter 1996-97)**
  - **Recurrence from 3 to 7 weeks (includes the classic Madden-Julian Oscillation)**
  - **West coast precipitation, central and eastern U.S. and Canada cold outbreaks, and Atlantic/Gulf Tropical Storm/Hurricane activity**
- ***Other***
  - **N. Atlantic Oscillation**
  - **Land/Surface Processes and Feedback: Southwest monsoon, soil moisture, snow, etc.**



Subseasonal Tropical-Extratropical Variability

Coupling of Tropical and Polar Events



- **No existing climate model has been shown to collectively or correctly treat more than half of the critical controls on North American weather.**

What about downscaling?

- ***Downscaling: Inferring climate variations on smaller spatial scales than resolution of climate model***

- **Models which don't represent the current climate well cannot be credibly downscaled statistically**
  - **for even the current climate with methods based only on observations**
  - **for the current climate with methods based on model corrections if either (a) the model is missing important variability or (b) observational data is limited**

- **Models of future climate cannot be credibly downscaled statistically because climate change is inherently a non-stationary process**

- **Nested model downscaling implies major technical challenges as well as assumptions about scale interactions if attempted for future climates (solution is global high-resolution models)**